Time and Size at Release Experiment: Four Releases of Three Size Categories of Juvenile Coho Salmon From the Capilano Hatchery in the Spring of 1981

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TIME AND SIZE AT RELEASE EXPERIMENT: FOUR RELEASES OF THREE SIZE CATEGORIES OF JUVENILE COHO SALMON FROM THE CAPILANO HATCHERY IN THE SPRING OF 1981.

by

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ABSTRACT

Bilton, H. T., R. B. Morley, and E. T. Stone. 1982. Time and size at release experiment: four releases of three size categories of juvenile coho salmon from the Capilano Hatchery in the spring of 1981. Can. Data Rep. Fish. Aquat. Sci. No. 347: iv + 18 p.

An experiment is currently in progress at the Capilano hatchery, North Vancouver, B.C., to measure the effects of time and size at release of juvenile coho salmon (Oncorhynchus kisutch) on their subsequent survival, growth, distributions, and age at maturity. In the spring of 1981, four releases (May 7, May 28, June 18, and July 9) of juvenile coho salmon each comprising three size groups were released from the Capilano River hatchery, representing a combined total of 138,119 marked and tagged fish. Prior to each release, samples of smolts were obtained for examination for disease, proximate analysis, sea water challenge tests, blood plasma sodium analysis, and histopathology. This report provides, in readily accessible form, background information required to assess the results of this experiment. Specific information on lengths, weights, sex compositions, health, and ability of released fish to adapt to sea water is provided.

Key words: Capilano, coho, data, size, release time.

RESUME

Bilton, H. T., R. B. Morley, and E. T. Stone. 1982. Time and size at release experiment: four releases of three size categories of juvenile coho salmon from the Capilano Hatchery in the spring of 1981. Can. Data Rep. Fish. Aquat. Sci. No. 347: iv + 18 p.

Une expérience est présentement en cours à la piscifacture de Capilano, Vancouver-Nord (C.-B.), en vue de mesurer les effets qu'ont le moment de la mise en liberté et la taille des saumons argentés juvéniles (Oncorhynchus kisutch) sur leur survie, leur croissance, leur répartition et leur âge à la maturité. Au printemps 1981, quatre mises en liberté (7 et 28 mai, 18 juin, 9 juillet), chacune constituée de trois groupes de longueur, ont eu lieu à la piscifacture de Capilano. Le total des saumons argentés juvéniles ainsi relâchés s'élève à 138 119 poissons marqués et étiquetés. Avant chaque mise en liberté, on a prélevé des échantillons de saumoneaux pour l'analyse des maladies, l'analyse immédiate, des essais de sensibilisation à la salinité, l'analyse du sodium du plasma sanguin et l'histopathologie. Ce

rapport présente, sous une forme d'accès facile, les données de base requises pour l'évaluation des résultats de l'expérience. Les données suivantes sont aussi présentées: longueur, poids, composition par sexe, état de santé et aptitude des poissns relâchés de s'adapter à l'eau de mer.

Mots-clés: Capilano, saumon argenté, données, taille, moment de mise ne liberté.

INTRODUCTION

The purpose of this report is to provide, in readily accessible form, background information required in a current experiment on the effects of time and size at release of juvenile Capilano River coho salmon (Oncorhynchus kisutch) on their subsequent survival, growth, distribution, and age at maturity. This report has been divided into three major sections: the first deals with the smolt releases; the second with disease; and the third with blood sodium analysis.

MATERIALS AND METHODS

A. Donor Stock and Rearing

A part of the production stock of 1979 brood Capilano eggs collected in the fall were used for the experiment. In an attempt to achieve three sizes of smolts (small, medium, large) by the time of their release in the spring of 1981, three groups of fertilized eggs assigned to the experiment were incubated from the "eyed" stage through to hatching at one of three different temperatures. Upon hatching, in the spring of 1980, the three groups of resultant fry were then reared separately in three Burrows ponds at the Capilano Hatchery until their release the following spring. During the rearing period, the fish were reared at production densities using the normal hatchery water supply. Fish of the small and medium size groups were fed Oregon moist pellets (OMP) according to hatchery feeding schedules. Fish of the large size group were also fed according to hatchery feeding schedules, except during early spring of 1981, when ration was reduced in an attempt to slow their growth.

B. EXPERIMENTAL DESIGN

Releases of three size categories of juvenile coho were made on each of four dates. For each release, approximately equal numbers of fish were removed from each of the three ponds containing either small, medium, or large fish. These fish were nose-tagged and marked in three equal replicates per size category to give statistical replication. Thus, there were nine distinctively tagged groups at each release, making a total of 36 groups for all four releases. The design was as shown below.

Size Category	Release date and number fish			
	May 7	May 28	June 18	July 9
Small	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
Total	12,000	12,000	12,000	12,000
Medium	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
Total	12,000	12,000	12,000	12,000
Large	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
Total	12,000	12,000	12,000	12,000
Grand Total	36,000	36,000	36,000	36,000

C. Nose-Tagging and Marking

All fish were tagged and marked during the spring of 1981. Those to be released on May 7 were tagged and marked April 21-25, twelve days prior to release. Those to be released on May 28 were tagged and marked May 12-16, twelve days prior to release. Those to be released on June 18 and July 9, were tagged and marked June 2-6, twelve days and thirty three days respectively, prior to release. At each of the first three tagging sessions, approximately 12,000 fish from each of the three ponds holding one of the three size groups of fish were removed, tagged, marked and accumulated and held until release in a single adult holding pond. Hence, this single pond at the end of a tagging session contained 12,000 small, 12,000 medium, and 12,000 large category fish. The 36,000 fish tagged for the July 9 release, were accumulated and held in an additional adult holding pond.

At the beginning of each tagging session for the first three releases, approximately 100 unmarked fish from each of the size groups (ponds) were randomly removed, killed, and retained for subsequent examination for length, weight and sex. These provided release samples for the first three releases (growth until release assumed to be negligible). For the fourth release (July 9) a release sample of 1,000 tagged fish was randomly removed from the adult holding pond on the day of release. These fish were killed and subsequently examined for length, weight, sex and tag-code. In addition, one or two days before each release, a random sample of 100 tagged fish from the adult holding pond was collected by the Diagnostic Service

section (G. Hoskins) for subsequent examination. Approximately 16 days before each release, samples of 40 untagged fish were taken from each of the small, medium, and large ponds by D. Higgs for subsequent proximate analysis. From the same fish samples were collected by J. Blackburn and sent to Dr. W. Zaugg (National Marine Fisheries Service, Cook, Washington, U.S.A.) for subsequent measurement of ATPase. Also at approximately 16 days before each release a sample of 30 untagged fish (10 from each of the small, medium, and large ponds) was collected by J. McBride for subsequent histopathological examination. Finally, approximately 16 days before each release a sample of 108 untagged fish (36 from each of the small, medium, and large ponds) was collected by C. Clarke for measurement of their ability to adapt to sea-water as measured by blood sodium levels after 24-h exposure to sea-water (Clarke and Blackburn 1977). On July 9, the day of the last release, a further sample of 108 tagged fish (random) was collected from the adult holding pond by C. Clarke.

Fish were released on May 7, May 28, June 18, and July 9, 1981.

RESULTS

NUMBER, SIZE, AND SEX RATIO OF SMOLTS RELEASED

The number of tagged fish released by release date for each of 9 groups are given in Tables 1-4. Also given in Tables 1-4 are estimates (based on release samples) of mean lengths and weights of fish by sex in each of the groups. For the first three releases, only one sample of the fish from each size group was taken. It was assumed that the size of the fish in the three replicates within a size category would be similar. Hence, Tables 1-3 show only one set of measurements for length, weight, and sex for each size category. For the fourth release (Table 4) where a sample of 1,000 tagged fish was taken; length, weight, and sex measurements for fish within each replicate were obtained. A measure of tag loss was also obtained; the estimated tag loss of 1.6% for fish of the fourth release has been applied to fish of the first three releases also. These estimates are shown in brackets in Tables 1-3. A total of 139,819 fish were tagged of which 138,119 were estimated to have a tag.

As indicated in Tables 1-4, the coefficients of variation for length and weight for the large fish in each of the first three releases were very high (52 to 65% for weight) indicating a disproportionate amount of size variability in the fish of this category. This resulted in considerable overlaps in the size distributions of fish of the medium and large size categories.

The sex ratios of smolts in release samples were compared using the 50% probability test (Langley 1979). In none of the 18 individual samples was there a significant difference ($P>.05$) in the sex ratios.

For each release, the sex ratios in the total sample from each size category (replicates combined for final release) were compared using chi-square (Langley 1979). In none of the releases were there any significant differences ($P>.05$) between proportions of males and females in the small, medium, or large categories. Examination of the sex ratios in the total samples from each release (sizes and replicates combined) also indicated sex ratios did not differ significantly between releases ($P>.05$).

Examination of the smolts for sex indicated there were two types of males. One group comprised males that had no indication of development of the gonads, and the other group males having various stages of gonad development. Results are summarized in Table 5. For smolts from the first release (May 7) 28 out of 328 fish (8.5%) were males with developing gonads. Among those from the second, third, and fourth releases (May 28, June 18, and July 9) 10.6%, 10.7% and 12.4% respectively, were males with maturing gonads. It is reasonable to speculate these are potential precocious males that will mature one year early and return as jacks in the fall of 1981. Comparison of the average weights of these fish with that of all males in the sample from each release group (Table 5) indicates the maturing smolts were the larger fish from each group. Furthermore, most of the maturing smolts originated from the large size category in each release.

2. DISEASE

This section was provided by the Diagnostic Services and summarizes the results of disease examinations of fish from each of the four releases.

The following samples of tagged coho smolts were randomly selected from the release ponds on dates indicated:

Lot no.	Collection Date	Number examined
81-140	April 4/81	100
81-172	May 7/81	100
81-212	May 28/81	100
81-271	July 7/81	100

METHODS

SAMPLING PROCEDURES

All fish were captured, fifteen to twenty at a time, by dip-net from 5-6 locations within the pond. Incidence of infectious disease and other pathological conditions was estimated by the methods outlined below:

1. Gross external and internal examination for signs of any abnormalities.

2. Aseptic streaking of kidney tissue onto Tryptic Soy Agar for the detection of bacterial disease agents.

3. Microscopic examination of kidney tissue smears for the detection of bacterial and parasitic agents.

4. Histological examination and evaluation of any abnormal tissues encountered.

RESULTS

Fin erosion was present in all four release groups, however, none of the groups were severely affected. Fin erosion is common among coho smolts reared in concrete ponds. Other observations were:

81-140 - single fish heavily infected with bacterial kidney disease (BKD).
- no other remarkable pathology was found.

81-172 - single fish lightly infected with BKD.
- another fish had a massive tumor, possibly a ganglioneuroma.
- a number of fish had a slight, white opacity to anterior margin of one or both eyes. Histologically a slight thickening of the peri-orbital epithelium could be seen but no causative agent found.

81-212 - no infectious agents were encountered.
- two fish had cataracts in both eyes.
- three fish had severe physical eye damage to the extent that their survival following release would be questionable.
- a number had the white opacity on anterior margin of the eye (as described above).

81-271 - 10 fish had moderate to severe eye damage. Ruptured eyeballs and damage to the tissue surrounding the eye suggest the cause was mechanical abrasion.
- at least three fish were slightly infected with with BKD.
- 10 additional fish had the white opacity in the anterior margin of both eyes.

CONCLUSIONS

All four lots of fish were reasonably free of infectious disease. No furunculosis and only low incidences of BKD were detected.

The cause of the thickening of the epithelial layer immediately anterior to the eye is not known but may have resulted from recent handling. Although a debilitating factor, the condition in itself would not greatly influence survival following release. More important was the severe mechanical damage observed in lot 81-271 which involved rupture of the eyeball. Ten percent of this random sample was affected. This observation is consistent with previous findings that prolonged holding of coho smolts results in gradual physical deterioration of the fish and enhanced susceptibility to infectious disease agents.

3. Blood Plasma Sodium Analysis

This section was provided by C. Clarke. Results of plasma sodium analysis of fish after 24-h exposure to seawater are summarized in Table 6. Seawater adaptability improved from March until mid May as evidenced by lower plasma sodium concentrations after 24 h in sea water. In June, plasma sodium levels after seawater transfer rose somewhat and by August, they were higher than in March. In general, larger fish adapted to sea water more readily than small individuals, but this difference was not particularly marked.

ACKNOWLEDGMENTS

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Table 1. Numbers of tagged coho smolts in the nine groups released at Capilano hatchery on May 7, 1981. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length mm									95% confidence limits	coeff. var.
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-19-01	4,377 (4,307)*	small	110.04	13.23	52	109.05	12.49	54	109.54	12.81	106	107.07 — 122.00	11.69
8-19-02	4,080 (4,015)	small	110.04	13.23									
8-19-03	4,221 (4,154)	small	110.04	13.23									
8-19-04	4,252 (4,184)	medium	123.73	15.30	44	120.98	16.22	65	122.73	15.84	109	119.08 — 125.10	12.97
8-19-05	4,346 (4,277)	medium	123.73	15.30									
8-19-06	4,488 (4,416)	medium	123.73	15.30									
8-19-07	3,496 (3,440)	large	128.78	23.71	56	125.38	23.04	57	127.07	23.33	113	122.72 — 131.42	18.36
8-19-08	3,485 (3,429)	large	128.78	23.71									
8-19-09	3,573 (3,516)	large	128.78	23.71									
Total	36,318 (35,738)												

Table 1. (cont'd)

Tag Code	Number tagged fish released	Size group	Weight g									95% confidence limits	coeff. var.
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-19-01	4,377 (4,307)*	small	15.04	5.33	52	14.80	4.70	54	14.92	5.00	106	13.96 — 15.88	33.50
8-19-02	4,080 (4,015)	small											
8-19-03	4,221 (4,154)	small											
8-19-04	4,252 (4,184)	medium	21.61	7.25	44	21.05	9.67	65	21.28	8.74	109	19.62 — 22.94	41.08
8-19-05	4,346 (4,277)	medium											
8-19-06	4,488 (4,416)	medium											
8-19-07	3,496 (3,440)	large	25.37	14.39	56	23.46	12.84	57	24.41	13.60	113	21.88 — 26.95	55.72
8-19-08	3,485 (3,429)	large											
8-19-09	3,573 (3,516)	large											
Total	36,318 (35,738)												

*Estimated number tagged fish released, based on the observed tag loss of 1.6% among 1,000 fish sampled for July 9 release.

Table 2. Numbers of tagged coho smolts in the nine groups released at Capilano hatchery on May 28, 1981. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length mm									95% confidence limits	coeff. var.
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-19-10	4,098 (4,033)*	small	112.17	16.32	60	109.44	14.13	52	110.90	15.34	112	108.03 — 113.77	13.83
8-19-11	4,093 (4,028)	small											
8-19-12	3,845 (3,784)	small											
8-19-13	3,983 (3,919)	medium	122.06	13.88	51	119.37	11.74	62	120.58	12.76	113	118.20 — 122.96	10.58
8-19-14	4,038 (3,973)	medium											
8-19-42	4,208 (4,141)	medium											
8-19-43	3,516 (3,460)	large	138.22	26.30	59	134.08	24.66	47	136.39	25.55	106	131.46 — 141.31	18.74
8-19-44	3,570 (3,513)	large											
8-19-45	3,565 (3,508)	large											
Total	34,916 (34,359)												

Table 2. (cont'd)

Tag Code	Number tagged fish released	Size group	Weight g									95% confidence limits	coeff. var.
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-19-10	4,098 (4,033)*	small	15.71	6.07	60	14.56	5.06	52	15.18	5.63	112	14.12 — 16.23	37.09
8-19-11	4,093 (4,028)	small											
8-19-12	3,845 (3,784)	small											
8-19-13	3,983 (3,919)	medium	20.75	7.44	51	18.86	6.42	62	19.71	6.93	113	18.42 — 21.00	35.16
8-19-14	4,038 (3,973)	medium											
8-19-42	4,208 (4,141)	medium											
8-19-43	3,516 (3,460)	large	30.93	17.06	59	28.38	15.82	47	29.80	16.49	106	26.62 — 32.98	64.92
8-19-44	3,570 (3,513)	large											
8-19-45	3,565 (3,508)	large											
Total	34,916 (34,359)												

*Estimated number tagged fish released, based on the observed tag loss of 1.6% among 1,000 fish sampled for July 9 release.

Table 3. Numbers of tagged coho smolts in the nine groups released at Capilano hatchery on June 18, 1981. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length mm									95% confidence limits	coeff. var.
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-19-46	4,100 (4,034)*	small	115.39	11.54	69	111.38	15.01	55	113.61	13.29	124	111.25 — 115.97	11.69
8-19-47	4,054 (3,989)	small											
8-19-48	4,078 (4,013)	small											
8-19-49	4,090 (4,025)	medium	123.14	16.91	58	122.35	12.16	68	122.71	14.48	126	120.16 — 125.27	11.80
8-19-50	4,048 (3,983)	medium											
8-19-51	4,212 (4,145)	medium											
8-19-52	3,570 (3,513)	large	141.74	22.02	58	140.52	26.93	48	141.19	24.25	106	136.52 — 145.86	17.18
8-19-53	3,567 (3,510)	large											
8-19-54	3,491 (3,435)	large											
Total	35,210 (34,647)												

Table 3. (cont'd)

Tag Code	Number tagged fish released	Size group	Weight g: Male $\bar{x}$	Male SD	Male N	Female $\bar{x}$	Female SD	Female N	Male and Female $\bar{x}$	Male and Female SD	Male and Female N	95% confidence limits	coeff. var.
8-19-46	4,100 (4,034)*	small	16.82	4.89	69	15.07	5.65	55	16.05	5.29	124	15.11 — 16.99	32.96
8-19-47	4,054 (3,989)	small											
8-19-48	4,078 (4,013)	small											
8-19-49	4,090 (4,025)	medium	20.92	8.57	58	20.10	6.03	68	20.48	7.29	126	19.19 — 21.77	35.59
8-19-50	4,048 (3,983)	medium											
8-19-51	4,212 (4,145)	medium											
8-19-52	3,570 (3,513)	large	32.00	15.14	58	30.91	18.04	48	31.51	16.44	106	28.34 — 34.67	52.19
8-19-53	3,567 (3,510)	large											
8-19-54	3,491 (3,435)	large											
Total	35,210 (34,647)												

*Estimated number tagged fish released, based on the observed tag loss of 1.6% among 1,000 fish sampled for July 9 release.

Table 4. Numbers of tagged coho smolts in the nine groups released at Capilano hatchery on July 9, 1981. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length mm									95% confidence limits	coeff. var.
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-19-55	3,882	small	125.85	10.73	62	122.21	10.94	62	124.03	10.95	124	122.08 — 125.98	8.83
8-19-56	3,786	small	125.52	11.11	52	122.12	8.78	59	123.71	10.04	111	121.82 — 125.60	8.11
8-19-57	3,949	small	126.16	10.79	44	120.09	11.09	42	123.20	11.29	86	120.78 — 125.62	9.17
8-19-58	3,847	medium	131.68	12.93	47	129.10	12.19	62	130.21	12.52	109	127.83 — 132.59	9.62
8-19-59	3,773	medium	134.36	12.47	55	132.31	10.76	73	133.19	11.52	128	131.18 — 135.21	8.65
8-19-60	3,884	medium	130.80	11.83	61	129.54	13.60	76	130.10	12.81	137	127.94 — 132.27	9.85
8-19-61	3,416	large	149.14	16.93	58	145.08	18.59	51	147.24	17.76	109	143.87 — 150.61	12.06
8-19-62	3,381	large	156.12	18.76	33	146.47	17.72	40	150.84	18.70	73	146.47 — 155.20	12.40
8-19-63	3,457	large	153.51	24.07	47	150.81	20.60	53	152.08	22.23	100	147.67 — 156.49	14.61
Total	33,375												

Table 4. (cont'd)

Tag Code	Number tagged fish released	Size group	Weight g									95% confidence limits	coeff. var.
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-19-55	3,882	small	21.18	5.28	62	19.46	5.05	62	20.32	5.21	124	19.39 — 21.25	25.66
8-19-56	3,786	small	20.62	4.91	52	19.29	4.27	59	19.92	4.61	111	19.05 — 20.79	23.13
8-19-57	3,949	small	21.49	5.59	44	18.65	5.03	42	20.10	5.48	86	18.93 — 21.28	27.28
8-19-58	3,847	medium	24.59	8.01	47	23.50	5.88	62	23.97	6.89	109	22.67 — 25.28	28.64
8-19-59	3,773	medium	26.39	6.93	55	25.15	6.55	73	25.68	6.72	128	24.50 — 26.85	26.16
8-19-60	3,884	medium	25.03	6.91	61	24.14	7.67	76	24.54	7.33	137	23.30 — 25.78	29.86
8-19-61	3,416	large	35.27	11.98	58	32.97	12.12	51	34.19	12.05	109	31.91 — 36.48	35.23
8-19-62	3,381	large	39.68	13.73	33	33.81	10.51	40	36.46	12.34	73	33.59 — 39.34	33.84
8-19-63	3,457	large	39.54	18.10	47	36.41	14.85	53	37.88	16.45	100	34.62 — 41.15	43.42
Total	33,375												

Table 5. The number, percent, and mean weight of maturing male smolts in the four release samples from the Capilano hatchery in 1981.

Tag Code	Release date	Size group	No. smolts sampled	Maturing males			Percent maturing males in sample	$\bar{x}$ weight all ♂ smolts (g)
				No.	$\bar{x}$ weight (g)	SD		
8-19- 1 8-19- 2 8-19- 3	May 7	small	106	4	21.62	0.84	3.77	15.04
8-19- 4 8-19- 5 8-19- 6		medium	109	6	27.22	4.35	5.50	21.61
8-19- 7 8-19- 8 8-19- 9		large	113	18	40.39	14.95	15.93	25.37
Total			328	28	34.89	14.27	8.54	
8-19-10 8-19-11 8-19-12	May 28	small	112	6	21.42	8.10	5.36	15.71
8-19-13 8-19-14 8-19-42		medium	113	10	28.55	7.61	8.85	20.75
8-19-43 8-19-44 8-19-45		large	106	19	45.63	16.57	17.92	30.93
Total			331	35	36.60	16.60	10.57	
8-19-46 8-19-47 8-19-48	June 18	small	124	8	23.29	4.27	6.45	16.82
8-19-49 8-19-50 8-19-51		medium	126	9	33.87	6.10	7.14	20.92
8-19-52 8-19-53 8-19-54		large	106	21	46.52	13.71	19.81	32.00
Total			356	38	38.63	14.31	10.67	

Table 5. (cont'd)

Tag Code	Release date	Size group	No. smolts sampled	Maturing males			Percent maturing males in sample	$\bar{x}$ weight all ♂ smolts (g)
				No.	$\bar{x}$ weight (g)	SD		
8-19-55	July 9	small	124	11	26.34	4.67	8.87	21.18
8-19-56		small	111	6	23.05	3.73	5.40	20.62
8-19-57		small	86	5	27.12	8.37	5.81	21.49
8-19-58		medium	109	10	32.28	11.89	9.17	24.59
8-19-59		medium	128	16	31.84	7.34	12.50	26.39
8-19-60		medium	137	13	28.55	5.29	9.49	25.03
8-19-61		large	109	23	41.90	11.68	21.10	35.27
8-19-62		large	73	11	50.58	14.26	15.07	39.68
8-19-63		large	100	26	47.32	16.03	26.00	39.54
Total			977	121	37.34	14.23	12.38	

Table 6. Plasma sodium levels after 24 h in sea water in coho sampled from Capilano hatchery in 1981.

Date	N	Fork Length (mm)*	Wet Weight (g)	Plasma sodium (meq/L)
March 30	30	112.9 ± 1.7	15.0 ± 0.7	176.8 ± 1.4
	30	114.6 ± 2.9	16.4 ± 1.3	172.6 ± 1.2
	30	119.4 ± 3.5	19.3 ± 1.5	175.9 ± 1.1
April 24	36	106.8 ± 2.2	12.5 ± 0.7	173.1 ± 1.4
	36	123.8 ± 2.8	18.9 ± 1.1	171.3 ± 0.9
	36	133.2 ± 3.2	24.9 ± 1.9	166.7 ± 0.5
May 15	36	110.0 ± 1.8	13.0 ± 0.6	167.9 ± 1.0
	36	117.6 ± 2.8	16.8 ± 1.2	167.5 ± 1.5
	36	137.3 ± 3.6	26.8 ± 2.2	164.0 ± 0.7
June 8	36	115.8 ± 2.4	14.6 ± 0.8	173.3 ± 1.9
	35	126.5 ± 2.9	20.0 ± 1.3	168.9 ± 1.3
	39	145.2 ± 3.4	30.6 ± 2.2	170.8 ± 1.0
June 23	33	123.2 ± 2.4	17.7 ± 0.9	174.3 ± 1.3
	36	134.3 ± 2.5	24.0 ± 1.3	174.5 ± 1.3
	25	155.3 ± 5.2	37.9 ± 3.6	168.9 ± 0.8
July 10	36	130.9 ± 2.2	22.5 ± 1.2	171.6 ± 1.2
	36	143.4 ± 3.6	31.5 ± 2.1	170.6 ± 1.2
	36	158.9 ± 3.0	39.1 ± 2.2	169.9 ± 1.0
Aug. 10	35	136.1 ± 2.9	25.4 ± 1.6	180.2 ± 1.2
	34	148.1 ± 3.6	34.9 ± 2.4	175.0 ± 1.1
	36	158.9 ± 3.8	40.4 ± 2.6	173.7 ± 1.2

*Mean ± SEM.